

Co-evolution of angiosperms and animals

Module-III

B.Sc 4th sem.

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- In the context of evolutionary biology, co-evolution refers to the evolution of at least two species, which occurs in a mutually dependent manner.
- Co-evolution was first described in the context of insects and flowering plants, and has since been applied to major evolutionary events, including sexual reproduction, infectious disease, and ecological communities.
- Co-evolution functions by reciprocal selective pressures on two or more species, analogous to an arms race in an attempt to outcompete each other.
- The interactions can be cooperative, as happens in a *symbiosis*, or more of an ongoing battle, as happens between predator and prey or plant-eater and plant. The evolutionary process where two species adapt to each other over time is called **co-evolution**.

Co-evolution is obvious throughout the angiosperms. The most well-known is the use of animals as **pollinators**, carriers of pollen from the male parts of a flower to the female parts of another flower.

These angiosperms have evolved ways to make their flowers stand out in the environment to their pollinators, both visually and with smells, and often present "rewards" such as food to bring pollinators back over and over.

The construction of a flower is often a clue to its pollinators. Many flowers without pollinators have no colors or odors, and pollen bearing and catching parts stick out in the air: these are wind-pollinated, common in many grasses. Some flowers are broad, with stumpy parts: these are often pollinated by crawling insects.

Some flowers are tall and narrow, with a central platform: these are commonly pollinated by flying insects, who press past the anthers on the way in and pick up pollen, then land on the next flower's pistil, leaving pollen there.

Flowers can give clues about their pollinators: the reason that red flowers rarely use bees (and often use beetles) as pollinators was a clue toward the discovery that bees don't see red as a color (although they can see ultraviolet as a color, and some bee-pollinated flowers are ultraviolet-colored). Fruits also have often evolved to use particular types of animals as seed-carriers, although the relationships are rarely as carrier-specific as those that have developed with pollinators.

Other types of coevolution exist in angiosperms: many defenses, such as thorns and poisons, are set against particular types of enemies. Many of the drugs that humans use recreationally are derived from the poisons plants have developed to fight their insect enemies: the active ingredients in tobacco, cocaine, and marijuana are all neurotoxins.

Co-evolution Examples

Predator-Prey Co-evolution

The predator-prey relationship is one of the most common examples of coevolution. In this respect, there is a selective pressure on the prey to avoid capture and thus, the predator must evolve to become more effective hunters. In this manner, predator-prey co-evolution is analogous to an evolutionary arms race and the development of specific adaptations, especially in prey species, to avoid or discourage predation

Acacia ants and Acacias

An example of co-evolution that is not characteristic of an arms race, but one which provides a mutual benefit to both a plant species and insect is that of the acacia ants and acacia plants. In this relationship, the plant and ants have coevolved to have a symbiotic relationship in which the ants provide the plant with protection against other potentially damaging insects, as well as other plants which may compete for nutrients and sunlight. In return, the plant provides the ants with shelter and essential nutrients for the ants and their growing larvae



Fig. Acacia ants and Acacias plant co-evolution

Flowering Plants and Pollinators

Another example of beneficial co-evolution is the relationship between flowering plants and the respective insect and bird species that pollinate them. In this respect, flowering plants and pollinators have developed co-adaptations that allow flowers to attract pollinators, and insects and birds have developed specialized adaptations for extracting nectar and pollen from the plants



Figure 20-11a
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Figure 20-12
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Figure 20-15
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Fig. Co-evolution of Flowering Plants and Pollinators